

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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# MULTIMEDIA UNIVERSITY

## SUPPLEMENTARY EXAMINATION

TRIMESTER 1, 2015/2016

**EEE1016 – ELECTRONICS 1**

(All Sections / Groups)

19 NOV 2015  
2.30 PM – 4.30 PM  
(2 HOURS)

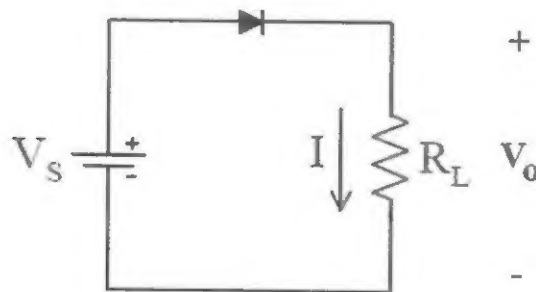
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### INSTRUCTION TO STUDENTS

1. This Question paper consists of **5 pages** including cover page with **4 Questions** only.
  2. Attempt **ALL** the questions. All questions carry equal marks and the distribution of the marks for each question is given.
  3. Please print all your answers in the answer Booklet provided.
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**QUESTION 1**

- (a) Explain why the electric current in a conductor is unipolar due to the flow of electrons only but the electric current in a semiconductor is bipolar due to the flow of electrons and holes at room temperature. [5 marks]
- (b) Explain how the conductivity of pure silicon can be increased by doping with impurities to produce an n-type semiconductor. [4 marks]
- (c) Consider a semiconductor sample at 300 °K having doped by  $8 \times 10^{14}$  donor atoms/cm<sup>3</sup> and  $2 \times 10^{14}$  acceptor atoms/cm<sup>3</sup>. Given that  $n_i = 1.75 \times 10^{13}$  cm<sup>-3</sup>,  $\mu_n = 4000$  cm<sup>2</sup>/V-s and  $\mu_p = 2000$  cm<sup>2</sup>/V-s.
- Determine the concentrations of holes and electrons. [6 marks]
  - What type of semiconductor is obtained? Explain. [2 marks]
  - Calculate the drift current density if an electric field of 2 V/cm is applied to the semiconductor. [3 marks]

**Figure Q1**

- (d) The diode in the circuit shown in Figure Q1 can be represented by the piecewise linear model with  $V_\gamma = 0.3$  V and  $R_f = 12$   $\Omega$ . Determine the output voltage  $V_o$  and current  $I$  in the circuit if  $V_S = 12$  V and  $R_L = 5$  k $\Omega$ . [5 marks]

**Continued ...**

## QUESTION 2

The rectifier shown in Figure Q2 is supplied from a 210 V, 60 Hz source. The output resistance  $R_L$  is 1 k $\Omega$ , capacitance  $C = 50 \mu\text{F}$  and the voltage drop across forward-biased diode  $D$  is 0.7V. Find the following values:

- Determine the peak voltage  $V_{p(m)}$  across the primary winding of the transformer. [2 marks]
- Calculate the *rms* and peak values of the secondary voltage  $V_1$ . [4 marks]
- Calculate the peak, the *rms* and the *dc* values of the output voltage of the rectifier,  $V_2$ . [6 marks]
- From results obtain in part (i), (ii) and (iii), compute the ripple factor  $\gamma$  of the rectifier circuit. [2 marks]
- Calculate the peak and average values of the secondary output voltage  $V_5$ . [8 marks]
- From the values obtained in part (e), calculate the ripple voltage  $V_r$  of the rectifier circuit. From the values obtained in part (e), calculate the ripple voltage  $V_r$  of the rectifier circuit. [3 marks]

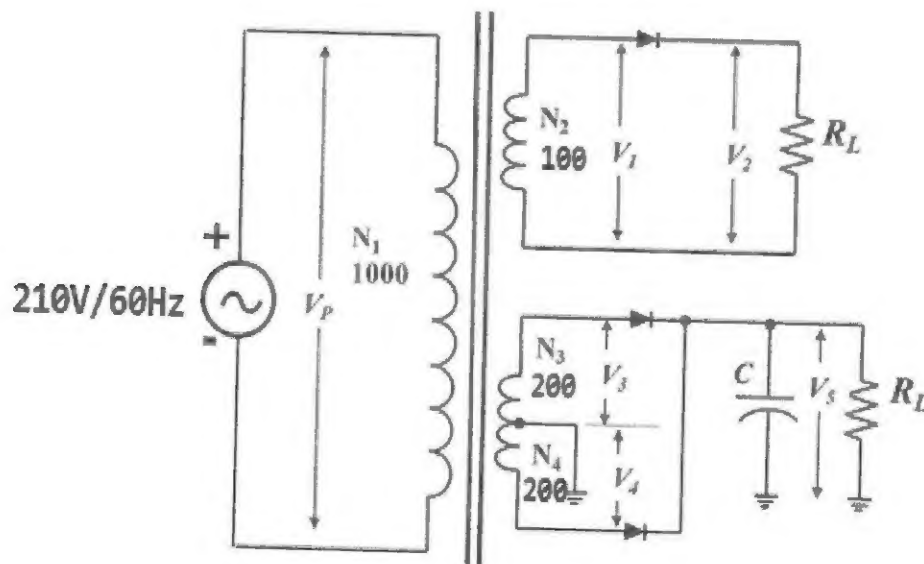
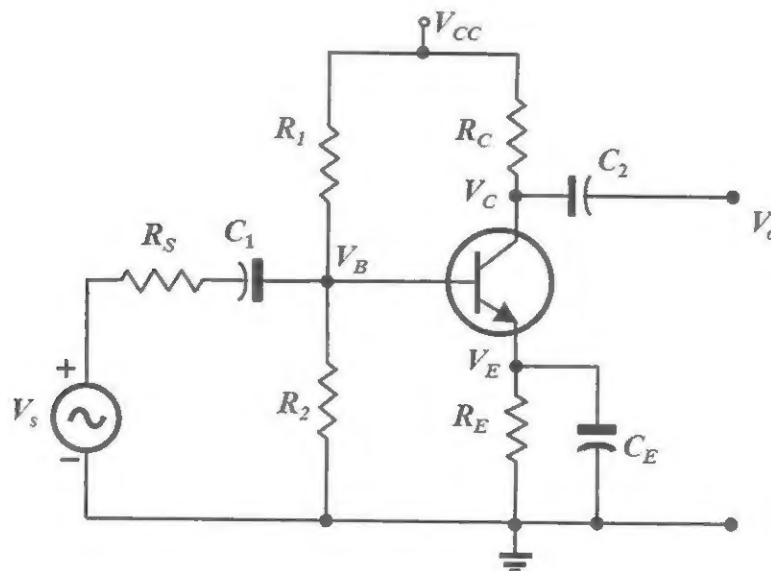


Figure Q2

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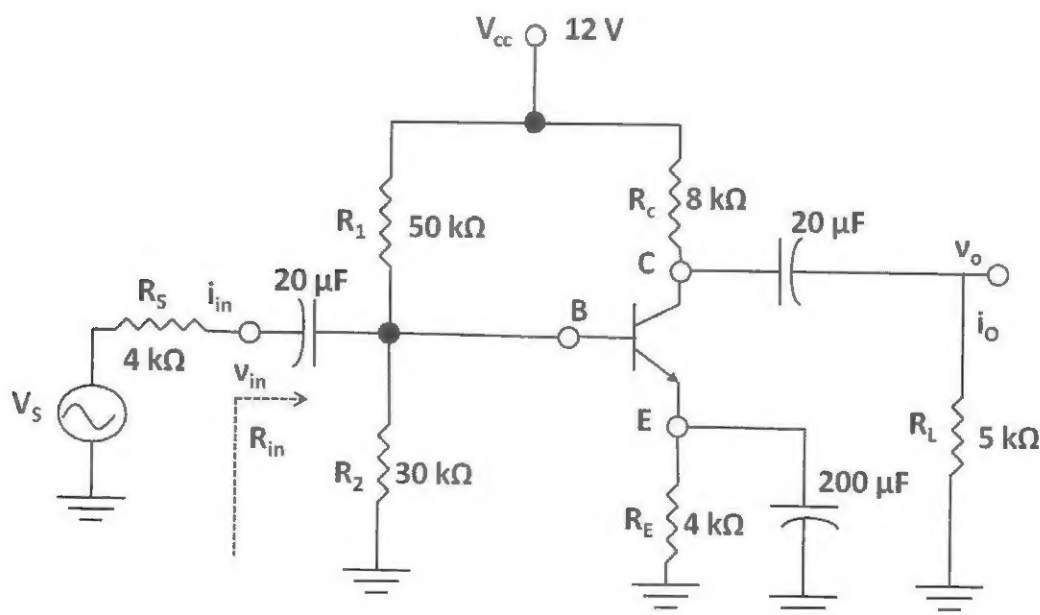
**QUESTION 3**

- (a) With proper labelling, illustrate the output characteristics of a common-emitter configuration of BJT and indicate the steps to determine the DC load-line and the values of  $I_{BQ}$ ,  $I_{CQ}$  and  $V_{CEQ}$  of common-emitter amplifier. [2+4 marks]
- (b) Describe any THREE typical amplifier features of a common-emitter amplifier. [3 marks]
- (c) For the amplifier circuit shown in Figure Q3,  $R_1 = 100\text{k}\Omega$ ,  $R_2 = 50\text{k}\Omega$ ,  $R_C = 5\text{k}\Omega$  and  $R_E = 3\text{k}\Omega$ . the amplifier circuit is connected to a DC supply,  $V_{CC} = 15\text{V}$ . Given that the amplification factor of the BJT,  $\beta = 100$  and  $V_{BE} = 0.7\text{V}$ .
- Draw the DC equivalent circuit of the amplifier circuit. [2 marks]
  - Simplify and draw thevenised DC equivalent circuit of the amplifier. [2 marks]
  - Determine the Thevenin's voltage,  $V_{TH}$ , and resistor,  $R_{TH}$ , of the simplified circuit. [4 marks]
  - Determine the emitter current  $I_E$  and the base current  $I_B$ . [4 marks]
  - Determine the voltages at  $V_B$ ,  $V_E$  and  $V_C$  nodes [4 marks]

**Figure Q3****Continued ...**

**Question 4**

- (a) Describe the impact for having a negative gain on the input and output current or voltage signal relationship for an amplifier circuit. [3 marks]
- (b) Describe three rules of thumb to be followed when constructing a transistor amplifier's AC equivalent circuit. [3 marks]
- (c) A current signal of 0.05mA was injected into the input of an amplifier circuit, and 15 mA current was obtained at the output of the amplifier. How much has the input current been amplified? [2 marks]
- (d) Figure Q4(d) below shows a BJT amplifier circuit. The transistor base-emitter voltage,  $V_{BE}$ , and Early voltage,  $V_A$ , are given as 0.7 V and 100 V, respectively. The current gain,  $\beta$ , of the BJT amplifier is given as 150.
- Determine whether the amplifier circuit of Figure Q4(d) is common-emitter, common-base or common collector. [2 marks]
  - Construct the small-signal  $r_e$  equivalent circuit for Figure Q4(d). [3 marks]
  - For the transistor  $r$ -parameters, calculate the emitter resistance,  $r_e$ , input resistance,  $r_b$ , and output resistance,  $r_o$ . [6 marks]
  - For the amplifier parameters, calculate the input resistance,  $R_{in}$ , and total AC load,  $R_L'$ . [4 marks]
  - Calculate the voltage gain with load ( $A_{v(WL)} = v_{o(WL)}/v_{in}$ ). [2 marks]

**Figure Q4(d)****End of Page**